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uation is completed through the fine stage, *B*. In this unit a portion of the high-pressure vapor from the central tube is allowed to expand to a low pressure through one or two small openings into the inverted cup, *C*. This vapor then escapes freely into the large water jacketed tube and gives the conditions essential for high-speed exhaustion.

It has found that the high-pressure stage operating alone, without assistance from the low-pressure unit, will produce a high vacuum. The speed of the high-pressure unit by itself, however, is very much less than that of the combination, which possesses a speed comparable with that of a single stage pump of equivalent proportions.

The advantage of the combined units, of course, lies in the fact that such a pump will function in a perfectly satisfactory fashion with a **very ordinary fore-vacuum**. A mechanical pump capable of reducing the pressure to 2 or 3 millimeters is satisfactory, or even a water aspirator which will give a vacuum of 20 millimeters can be used if nothing better is available.

With regard to the construction of the pump perhaps a little may be said. Glass possessing a low coefficient of expansion such as Pyrex or Corning G702P glass must be used in making it, as otherwise one will almost certainly experience the rather annoying inconvenience of having the boiler crack upon application of the heat. The size of the pump can, of course, be varied considerably, but the general proportions of the parts given in the drawing are found to be very satisfactory. In the pump from which the drawing was made the mercury boiler has a diameter of 90 millimeters and the other dimensions were reduced proportionately. The dimensions of the jet and throat which have been found to work well are indicated in the enlarged sketch of this part. The diameters given apply to the tube openings. The thickness of the nozzle wall should be as thin as is consistent with reasonable strength. The two small openings which serve to furnish a supply of vapor to the upper unit are about the size of ordi-

nary pin holes and are located on opposite sides of a small enlargement in the central tube. The joint between the lower end of the water jacket and the body of the pump is made water tight by binding it tightly with strips of thin rubber. There is some advantage in having a slight constriction where the mercury return tube is sealed to the boiler as the presence of a constriction here tends to preserve the equilibrium of the mercury in the return tube.

The mercury in the boiler should be about 2 centimeters in depth at the center and ordinarily, with a properly adjusted flame, it will evaporate without serious bumping even at the higher pressures. The height of the mercury column in the return tube indicates the vapor pressure in the boiler and the pressure required for satisfactory pumping depends entirely upon the fore-vacuum. There is no harm, however, in running the vapor pressure up as high as the length of the return tube will permit if this be necessary to enable the pump to function.

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THE AMERICAN CHEMICAL SOCIETY

(Continued)

DIVISION OF AGRICULTURAL AND FOOD CHEMISTRY

C. E. Coates, Chairman
T. J. Bryan, Secretary

The testing and grading of food gelatins: CLARKE E. DAVIS AND EARL T. OAKES. Loeb's recent work on gelatin is briefly discussed and Bancroft's objections to Loeb's conclusions on the basis of the insolubility of gelatin as based on surface tension measurements by Slobeki are shown to be in error. Methods for determining gel strength and viscosity are given and the effects of various factors affecting these properties are discussed with data. Data on the causes for discrepancies between grading gelatins by gel strength tests and by viscosity measurements are given. Gelatins submitted by the manufacturers as examples in which gel strength does not parallel viscosity are shown to be classified alike by gel strength and viscosity measurements under the methods described.

Active chlorine as a germicide for milk and

milk products: HARRISON HALE AND WILLIAM L. BLEECKER. The increasing and satisfactory use of active chlorine as a germicide for water suggests the possibility of its use for milk and milk products. Numerous bacteriological tests show a reduction in number of bacteria in general proportional to the amount of active chlorine present. Chlorine water, sodium hypochlorite and calcium hypochlorite solutions were used on milk and ice cream in dilutions varying from 1 part of active chlorine to 1000 parts of milk to 1 part to 100,000. Chlorine water in 45 minutes produces practically the same results that sodium hypochlorite does in 1½ hours and calcium hypochlorite in 19 hours.

The inadequacy of analytical data: H. E. BARNARD.

The chemistry of leavening agents: CLARK E. DAVIS AND D. J. MAVEETY.

Availability of salts in soils as indicated by soil colloids: N. E. GORDON. Iron, alumina and silica gels were prepared in the purest possible condition and shaken with various salt solutions until equilibrium was established. The maximum adsorption was determined. Then by a series of washings it was found in what way and to what extent the adsorbed salt became available for plant food. Furthermore, a series of experiments showed that the hydrogen-ion concentration plays a very important rôle in the availability of salts which are held by soil colloids.

The effect of pectin, acid and sugar on the character of gels: C. A. PETERS AND R. K. STRATFORD. Pectin extracted from apple pumace by water was used and a standardized method for making gels in 10 c.c. portions was developed. Acidity of 0.3 per cent. was necessary for gelation and acid above 0.3 per cent. did not increase the stiffness of gels. As the per cent. of pectin was increased the amount of sugar had to be increased to make the stiffest gel; with a certain per cent. of pectin less sugar makes a softer gel, an increase of sugar makes a stiffer gel while a further increase of sugar makes a gel less stiff. The character of the gel depends upon the hydrolysis of both the sugar and pectin.

Nutritive studies of the Georgia velvet bean, Stizolobium Deeringianum. III. *Supplementary relationship of whole and skimmed milk to the hulled seed and the whole plant:* J. W. READ AND BARNETT SURE. An earlier paper¹ in this series of studies

¹ "Biological Analysis of the Seed of the Georgia Velvet Bean, *Stizolobium Deeringianum*," *Jour. Agr. Res.*, Vol. XXII., No. 1, pp. 5-18.

on the nutritive value of the Georgia velvet bean showed that the raw bean is injurious to rats. If the ration is supplemented with a liberal supply of whole milk, rats grew at a rate even more rapid than normal, and three generations were successfully reared on this diet. Inasmuch as previous work had shown the velvet bean to be quite rich in the fat-soluble vitamins, experiments employing skimmed milk instead of whole milk and replacing the dextrin by starch were tried, but rearing of the young in two cases was not successful. In the case of the whole plant, however, a healthy and vigorous third generation was secured on such a simple and poorly constituted diet as that composed of 40 per cent. velvet bean hay (ground whole plant), 60 per cent. starch, and a liberal supply of skimmed milk.

Nutritive value of the Georgia velvet bean (Stizolobium Deeringianum). (a) *Supplementary relationship of leaf and the hulls of seed.* (b) *Nutritive value of the whole plant:* BARNETT SURE AND J. W. READ. Our previous work² on the nutritive value of the Georgia velvet bean showed the seed to be abundant in the fat-soluble vitamins, but deficient in protein, salts, and the water-soluble vitamins. In this study we have found the leaf to be abundant in the water soluble and an efficient carrier of salts. The hulls, however, possessed no supplementary value to the seed, and they interfered with the utilization of the fat-soluble vitamins in the seed, as did also the velvet bean hay. Autoclaving the hulls for two hours at 15 pounds pressure did not change their disturbing effect. The data secured suggest that the interference with the utilization of the fat-soluble vitamins may possibly be due to indigestible celluloses.

Calcium chloride as a mineral supplement in the ration. (Preliminary report): J. W. READ AND BARNETT SURE. The literature contains the results of experiments conducted by several investigators within the last eight or ten years on the benefits derived from the addition of small quantities of calcium chloride to the ration. We considered it of possible value to check up on some of the results which have been reported, and have in progress certain experiments with rats, in which cotton seed meal constitutes 35 and 50 per cent. of the two basal rations which receive calcium chloride additions varying from 0.60 to 16.00 grams of the tetrahydrate salt per kilogram of ration. The rations receiving calcium chloride are compared to the controls free from salt additions, and to rations receiv-

² *Jour. Agr. Res.*, XXI., No. 9.

ing sodium chloride and calcium carbonate. Our results to date show rather remarkable responses to small amounts of calcium chloride, even as low as 0.6 of a gram to a kilogram of ration proves to be as effective as any of the higher additions of this salt. At this time, however, our experiments have not been in progress long enough to permit any definite conclusions, but they are being continued and will be reported later.

Sugar beets in Louisiana: C. E. COATES AND A. F. KIDDER. A long series of results show that it is possible to grow sugar beets of high sucrose and high purity in Louisiana and to obtain heavy yields. This is probably true for the South in general. The best results are obtained by late spring planting. The yields average 18 tons per acre; the purities about 85.0 and the sucrose 14.0. The essential feature is the necessity for obtaining good beet seed which breed true to type. Seed grown in the United States today fulfill these requirements.

Causes of hominy black. EDWARD F. KOHMAN.

The volatile acids and the volatile oxidizable substances of cream and experimental butter: L. W. FERRIS. In collaboration with Dr. H. W. REDFIELD AND W. R. NORTH. There has been found a noticeable difference between the amount of volatile acids found by distillation without saponification in butter made from sweet cream and the amount found in butter made from sour cream, the acidity of which had been reduced before pasteurization. The amount of volatile oxidizable substances was high and the lactose very low on the samples of butter made from cream which contained the higher numbers of lactose-splitting yeasts.

Some determinations on the soluble nitrogen compounds of cream and butter: L. W. FERRIS. The paper gives some of the results obtained in connection with an investigation of cream and butter conducted by Dr. H. W. Redfield and continued by the author. The report shows the relation of amino nitrogen and ammonia to total nitrogen and the relation of the nitrogen not precipitated by phosphotungstic acid to total nitrogen in cream and in butter when fresh and after being held under different conditions of storage. The greatest per cent. of such nitrogen, when the butter was fresh, and also the greatest increase during storage, was found in butter made from cream which had been allowed to sour before being pasteurized.

A method for the determination of amino nitrogen and ammonia in cream and butter: L. W. FERRIS. Picric acid and acetic acid are used to separate the protein and higher complex substances

from the lower degradation products. The amount of nitrogen in the filtrate reacting with nitrous acid in Van Slyke's amino acid apparatus is determined. The filtrate can be held for some time without change in the amount of reacting nitrogen, and hydrolysis of the proteins during analysis is reduced to a minimum. It is found that there is a correlation between the ratio of the amino and ammonia nitrogen to the total nitrogen, and the quality of the sample.

The viscosity of natural and "remade milk." Food control laboratory: OSCAR L. EVENSON AND LESLIE W. FERRIS. The relation of viscosity to total solids is shown by means of the expression:

$\frac{v-1}{T.S.}$, in which

$$v = \frac{\text{Time of flow of milk} \times \text{sp. gr. of milk}}{\text{Time of flow of water} \times \text{sp. gr. of water}}$$

T. S. equals total solids. For a given number of samples, the values for $(v-1)/T.S.$ for natural milk varies from 5.68 to 7.18 and for remade milk from 6.37 to 12.60 at 25° C. The viscosity of milk as determined is, to a certain extent, dependent upon the temperature at which the milk has been held. Homogenizing at a high pressure increases the viscosity while emulsifying has little or no effect.

Composition basis for considering the water requirements of plants: H. A. NOYES. Higher moisture contents in orchard soils were found to occur on those plots where increased bacterial activities resulting from aeration of the soil had increased plant growth and markedly changed the analyses of the plants. As the result of the field work, given above, controlled greenhouse investigations were undertaken with different fertilizer treatments to study variations in analysis as related to changes in the water requirement of plants. In one set of experiments the water requirement (per unit of dry matter) decreased from 1,785 to 1,215 with a variation of 15 per cent. in the nitrogen content and 23 per cent. in the ash content of plants grown under different fertilizer treatments. A second set of experiments on a different soil and with a different crop showed a variation in water requirement of from 37.9 to 16.1 (per unit green weight) with a variation of 74 per cent. nitrogen content, 176 per cent. in phosphorus content of ash and 66 per cent. in the ash content of plants grown under different fertilizer treatments. The hypothesis adopted on the basis of these results is that when a soil that will respond to fertilizer treatment (direct or indirect) is fertilized the plants growing in that

soil are able to make their growth (approach normal) on less moisture and analyze differently than they otherwise would.

DIVISION OF DYE CHEMISTRY

A. B. Davis, Chairman

R. Norris Shreve, Secretary

The dye situation in Canada: W. F. PRESCOTT.

Contribution to the chemistry of cyan-xanthen and cyan-acridinium: GEORGE HEYL. In the course of researches undertaken with a view of introducing into the acridinium molecule other groups to render the dye more toxic toward certain pathogenic organisms, it was found that a number of new dyes can be produced, heretofore not recorded. The development of these new dyes is accompanied by structural formulae and notes on the laboratory technique used. The biological value of the cyan dyes is not discussed, as the biological experiments are as yet incomplete.

Lakes from phenetidin: DR. J. C. SCHMIDT. Phenetidin and derivatives when diazotized and coupled with beta naphthol or R salt form colors that range in shade from an orange to scarlet and to deep maroon. Some of these pigments are soluble, others insoluble in oils. These colors are remarkable for fastness to light and brilliancy, rivaling those produced from alizarine. Their qualities make them valuable for the manufacture of lakes for printing ink, and painting purposes, varnish stains, coloring waxes and paraffin also for printing textiles.

The synthesis of anthraquinone from phthalic anhydride and benzene: E. R. HARDING. The Friedel Crafts reaction for the preparation of ortho benzoyl benzoic acid was studied extensively. Phthalic anhydride reacts with benzene and aluminum chloride to give an unstable intermediate compound which is easily decomposed to give a salt of benzoyl benzoic acid. This acid is readily converted to anthraquinone by heating with sulfuric acid. The yields throughout are good. The process is commercially attractive because the raw materials are abundant and comparatively low priced. Anthraquinone produced from anthracene so far has been expensive on account of the cost of anthracene, the removal of which from tar leaves a pitch of low value.

A direct reading spectrophotometer for measuring the transmissivity of liquids: IRWIN G. PRIEST. This instrument has been designed to provide means for rapid and convenient as well as accurate

work, particularly in the technologic examination of dye solutions and oils. It consists essentially of a combination of a constant deviation wave-length spectrometer and the author's "exponential" or "variation of thickness" photometer. Wave-length and transmissive index ("extinction coefficient") are both read *directly* from the instrument scales without any computation. A model instrument constructed in the Bureau of Standards Instrument Shop was exhibited at the Chemical Exposition Sept. 12-17, 1921. The instrument will be fully described in a forthcoming Bureau of Standards publication to which reference should be made for details. Interested persons may have their names placed on the mailing list for this paper by addressing the Bureau of Standards, Div. IV, Sec. 3, Washington, D. C.

Naphthalene sulphonic acids. IV. The solubilities of some amino salts of naphthalene sulphonic acids: H. WALES. Solubilities of the salts of alpha and beta naphthylamine with some naphthalene sulphonic acids have been determined between 25° and 98° C. Allotropic changes are indicated for two of the salts and an interesting relation between the solubility and structure of a series of isomers is shown.

The preparation of alpha gamma quinolines. I. 2, 4 dimethyl, 6 ethoxy quinoline: An improved method for its preparation and a study of the condensation: S. PALKIN AND M. HARRIS. A study has been made of the conditions affecting the yield and quality of 2, 4 dimethyl, 6 ethoxy quinoline as prepared by the Beyer (Pfitzinger) synthesis for alpha gamma quinolines. Tolerance toward water and temperature variation and effect of oxidation in the synthesis; also relative effectiveness of purification reactions introduced by Mikeska for the recovery of pure base have been investigated. Boiling range curves (at 30 mm.) for the base at different stages of purification have been worked out. One of the principal difficulties incident to the recovery of the base from the reaction mixture, has been overcome by the application of a steam treatment rendering possible the elimination of tedious extractions or steam distillations. An improved process (depending on the Beyer-Pfitzinger synthesis) for 2, 4 dimethyl, 6 ethoxy quinoline, is described, which is much simpler of manipulation, requires less time to carry out, is adaptable to larger scale operation, and yields 10 to 15 per cent, more pure base than by the former method.

CHARLES L. PARSONS,
Secretary